PCT/AU2004/000933

REC'D 28 JUL 2004
WIPO PCT

Patent Office
Canberra

I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2003903578 for a patent by BHP STEEL LIMITED as filed on 11 July 2003.

I further certify that the name of the applicant has been amended to BLUESCOPE STEEL LIMITED pursuant to the provisions of Section 104 of the Patents Act 1990.

WITNESS my hand this
Twenty-first day of July 2004

J. Billingsley

JULIE BILLINGSLEY
TEAM LEADER EXAMINATION
SUPPORT AND SALES

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

ß

AUSTRALIA

Patents Act 1990

PROVISIONAL SPECIFICATION

Applicant(s):

BHP STEEL LIMITED

A.C.N. 000 011 058

Invention Title:

IMPROVED WATER TANK AND METHOD OF MAKING SAME

The invention is described in the following statement:

IMPROVED WATER TANK AND METHOD OF MAKING SAME

Technical Field

The present invention relates generally to liquid storage systems and more specifically to improvements in metal water tanks. The invention has been developed especially, but not exclusively, for rain water storage tanks for domestic use and is herein described in that context. However, it is to be appreciated that the invention has broader applications and is not limited to that particular use.

Background of the Invention

Traditionally, metal rainwater tanks have been made from corrugated metal panels which are formed with a circular cross section. The use of this cylindrical form is beneficial as it ideally suited to accommodate the hoop tension induced in the tank by the hydrostatic pressures of the water. Whilst the cylindrical water tanks are ideally suited to resist the hydrostatic pressures, they are not particularly well suited for domestic applications because of aesthetic reasons and also because of space requirements.

In view of these limitations, in recent times, new designs of water tanks have been developed primarily for domestic use. The designs are generally of a rectangular cross section where the major front and back faces are significantly longer than side walls which interconnect the front and back faces. These designs are ideally suited to be located against a building wall where there is more likely to be more room to accommodate the tank and also where it will be less intrusive.

In the past, difficulties have been encountered in producing tanks, either in the original cylindrical form, or in the generally rectangular form, that are easy to

manufacture and which are well suited to accommodate the hydrostatic pressures induced in the tank. Traditionally, prior art metal circular water tanks are assembled by hand thereby limiting the opportunity to reduce the cost of manufacture of such tanks. Plastic versions of these tanks are not self supporting and therefore require separate support and frames to be provided. These frames typically require extensive bridging which extend intermediate the tank and as such, the frames not only significantly increase the cost of manufacture of the tank, but can substantially reduce its storage capacity.

Summary of the Invention

An aim of the present invention is to provide improvements to the design of the metal tanks which ameliorate at least some of the above problems. A particular aim is to provide a design of water tank which is able to be manufactured rapidly in a production line facility.

In a first aspect, the invention provides a water storage tank having a base, and a peripheral wall upstanding from the base and extending about a central axis of the tank, the peripheral wall being formed from one or more lengths of sheet material, each sheet being helically wound about the tank axis, at least one of the sheets being formed of metal strip having at least one stiffening formation disposed between opposite longitudinal edges of the sheet, the wall further comprising at least one seam extending helically about the tank axis and forming a join at the longitudinal edges of the or each sheet so that the peripheral wall is continuous.

Accordingly, the present invention provides a water storage tank which is characterised in that the peripheral wall is formed from a helical wound length of one or more sheets of material. This approach has substantial

practical benefits as it enables the peripheral wall of the tanks to be formed in a continuous process whereby the sheet strip is initially formed into a continuous cylinder by helically winding the sheet strip about a central axis. The wall cylinder is made continuous by forming a join at the longitudinal edges of the or each sheet strip and the cylinder is then cut into discrete lengths to form the individual peripheral walls. Accordingly, by providing the peripheral wall in this construction it is possible to produce at least a major portion of the water tanks in a production line fashion.

If the peripheral wall is formed from one length of sheet material, then the wall is formed as a single helix. Alternatively, if the peripheral wall is formed from two lengths of sheet material then the peripheral wall forms a double helix. To simplify the manufacturing process of the water tanks, it is preferred that the peripheral wall is formed from a single length of metal sheet strip which is profiled to include at least one stiffening formation. However, forming the wall from more than one length of sheet material enables the introduction of materials of different characteristics (ie. materiel thickness, strength, material type) so as to optimise the performance of the tank relative to the costs of material. In addition, as the water tanks may be used in areas where they are quite visible, it is possible to create tanks which have more visual impact by making the peripheral wall from more than one length of sheet material. For example, the peripheral wall can be two toned by making them from two lengths of sheet metal strip which are of different colours.

In one form, each of the stiffening formations includes at least one rib that extends helically about the tank axis. Typically in this arrangement, the stiffening formation is preformed in the sheet metal strip and extends longitudinally in the direction of the sheet strip.

In one embodiment, the stiffening formations are formed as ribs that are interspaced by pans. In that application, in one form the ribs extend inwardly into the water tank so that the pans form the outer limit of the external face of the peripheral wall. In another form, the ribs extend outwardly. In another form, the stiffening formations are in the form of corrugations or a plurality of ribs or pleats, such that cross sectional profile of the metal sheet strip displays a regular wave form with crests and troughs displacing from the centre plane of the sheet. The wave form may be smoothly curved throughout or it may comprise straight portions meeting at relatively abrupt angles, or a combination of both these possibilities.

In the embodiment where the stiffening formations are generally linear in the longitudinal direction of the rib it is preferable that the pitch angle of each rib is relatively low. The advantage of a low angle of pitch is that it enables the tank wall to better accommodate the hydrostatic pressures in the tank.

In an alternative form, the stiffening formations include a plurality of ribs or corrugations that extend generally in the direction of the tank axis. The stiffening formations may be used in conjunction with the helical stiffening formations or possibly in place of those stiffening formations. The advantage of the generally vertical stiffening formations is that they can minimise bulging of the peripheral wall. These stiffening formations may be in the form of microflutes or may take the form of other larger ribs.

An advantage of using a profiled metal sheet according to any of the forms above is that the metal sheet strip can be profiled through a continuous cold roll forming process. As such, the use of metal profiles of this type can be included in a continuous production process whereby the metal strip is initially cold roll formed then helically wound to form the cylinder and cut

into peripheral walls of discrete length in a single production line.

In one form the peripheral wall of the water tank is circular in cross section perpendicular to the tank axis. However, in an alternative form, the cross section of the peripheral wall may be non circular and more preferably is either generally elliptical or obround (ie having substantially parallel front and back faces and generally semi-circular or arcuate sides). This latter arrangement is ideally suited to domestic use where the water tank can be mounted against a building wall or the like.

In one form, the peripheral wall may be formed in its final cross sectional shape. In such an arrangement, each metal sheet strip may be helically wound to provide a continuous cylinder of either circular or non circular cross section.

In an alternative arrangement, the peripheral wall is originally formed to have a particular cross section (typically circular) and is then post formed into its final shape. This may be achieved through the use of mandrels or the like which are inserted within the cylinder. The mandrels include outer engaging surfaces and are movable relative to each other to force a change of shape on the peripheral wall. Where the peripheral wall has its shape changed as part of its manufacture, this change may occur whilst the individual peripheral walls are in the form of a continuous cylinder or alternatively may occur once the cylinder is cut at the discrete intervals to form the individual peripheral walls.

In a preferred form, the lower edge at least of the peripheral wall is generally planar and disposed perpendicular to the tank axis. Typically this lower edge is formed on cutting the cylinder at the discrete intervals. A similar arrangement is also preferably formed at the upper edge of the peripheral wall.

Preferably the base is formed from sheet material and

more preferably metal, and is interconnected to the lower edge of the peripheral wall by a seam connection. In a particularly preferred form, the seam joining the base with the peripheral wall comprises a roll formed lock seam. The advantage of this arrangement is that the interconnection of the base with the peripheral wall can also form part of a continuous production process. To adequately seal the base to the peripheral wall, particularly in the vicinity of where the rib intersects the seam, the seam may need to be completed through a crimping or similar operation at these regions.

In one form, internal spacers are disposed within the peripheral wall. These spacers interconnect portions of the peripheral wall and are operative to resist outward bowing of the peripheral wall. In one form, the spacers comprise a plurality of metal ties.

In addition, if required, reinforcing elements may be provided adjacent the base of the water tank where the hydrostatic pressures are at their greatest. In one form, these additional reinforcing elements are in the form of metal flanges which abut the outer surface of the peripheral wall and the base of the tank.

In a further aspect, the present invention relates to a method of manufacturing a water storage tank having a base and a tank wall upstanding from the base, the method comprising the steps of:

- helically winding at least one length of sheet material about a central axis to form a cylinder;
- forming a join at the longitudinal edges of the or each sheet so that the wall of the cylinder is continuous;
- cutting the cylinder transverse to the central axis to separate the tank wall from the cylinder;
- locating a base at one end of the tank wall; and

joining the base to the tank wall.

In one embodiment wherein one of the lengths of sheet material is sheet metal strip, the method further comprises roll forming the sheet metal strip to

incorporate stiffening formations in the sheet, and using the roll formed sheet in forming the cylinder.

Preferably, the method according to this aspect of the invention is carried out in a production line facility wherein the steps are repeated to produce a plurality of water tanks. In particular, preferably the cylinder is formed by a continuous process from at least one coil of sheet material.

In yet a further aspect, the invention relates to a production line facility to manufacture the water storage tanks.

In yet a further aspect, the present invention relates to a method of manufacturing water storage tanks having a base and a peripheral wall upstanding from the base, wherein the peripheral wall of a plurality of tanks is formed in continuous process by helically winding at least one length of sheet material about a central axis to form a cylinder, forming a join at the longitudinal edges of the or each sheet strip so that the wall of the cylinder is continuous, and cutting the cylinder at discrete intervals to form the individual peripheral walls.

Brief Description of the Drawings

It is convenient to hereinafter describe embodiments of the present invention with reference to the accompanying drawings. Particularly of these drawings and the related description is to be understood as not superseding the generality of the preceding broad description of the invention.

In the drawings:

Figure 1 is a perspective view of a water tank according to an embodiment of the present invention;

Figure 2 is a planar view of the tank of figure 1;

Figure 3 is a perspective view of a sheet metal strip including a ribbed profile for use in the water tank of

figure 1.

Figure 4a is an alternative metal strip profile for the tank of figure 1;

Figure 4b is a further alternative profile of the metal strip for use in the tank of figure 1;

Figures 5a to 5c are schematic illustrations of the manufacture of the join at the base of the water tank of figure 1;

Figure 6 is a detail of the helical seam in the peripheral wall of the tank of figure 1;

Figure 7 illustrates a cross section of a peripheral wall incorporating a mandrel used in construction of the tank of figure 1;

Figure 8 is a cross sectional profile of the peripheral wall of the tank of figure 1 using the mandrels of figure 7;

Figure 9 is an alternative cross sectional to the profile of the tank of figure 8;

Figure 10 is a side view of the tank of figure 1 incorporating stiffening flanges;

Figure 11 is an end elevation of the tank of figure 10;

Figure 12 is a schematic cross sectional view of the tank of figure 1 incorporating internal ties;

Figure 13 is a variation on the tank illustrated in figure 12; and

Figure 14 is a schematic view of a production facility for manufacturing water tanks.

Detailed Description of the Drawings

Turning firstly to figures 1 and 2, a rain water storage tank 10 is disclosed which is generally obround in cross section. The tank includes a base 11 and peripheral wall 12 which extends upwardly from the base. The peripheral wall 12 includes opposite generally parallel sides 13 and 14 and generally semi-circular ends 15 and

16.

The tank 10 is made from sheet metal, with the peripheral wall 12 being formed by a single length of metal sheet 17, which is helically wound around a central axis (CA) of the tank. To ensure that the peripheral wall 12 is continuous, a lock seam 20 is provided which interconnect the opposing longitudinal edges 18, 19 (see figure 3) of the sheet metal strip 17. The lock seam 20 similarly extends helically about the tank axis CA.

As best illustrated in figure 3, the sheet metal strip 17 is profiled to include a plurality of ribs 21 which extend in the longitudinal direction of the sheet metal strip 17. In the illustrated form of figure 3, the sheet metal strip is profiled to include three ribs 21 which are in close proximity to each other and pans 22 located adjacent the ribs 21.

The ribs 21 are provided to stiffen the sheet strip 17 so that it is better able to accommodate the hydrostatic pressures induced in use of the tank 10. These ribs are typically formed from a cold roll form operation. It needs to be appreciated however that other profiles may be used as will be appreciated by those skilled in the art. Examples of other profiles are illustrated in figures 4a and 4b. In the embodiment of figure 4a, the pan sections 22 disposed between the ribs 21 incorporate a series of transverse flutes 23 that are inclined both to the longitudinal ribs 22 and to the lateral axis of the sheet 17. These flutes, which are typically microflutes, are inclined in this way so that when the sheet 17 is helically wound to form the peripheral wall 12, the microflutes extend substantially vertically (ie. in the direction of the tank axis CA). The purpose of the flutes is to further increase the strength of the sheet metal strip so as to resist bulging of the sheet intermediate the ribs 21. In a further form, the flutes may extend laterally across the sheet so that when the sheet is wound on to form the peripheral wall 12,

they extend at an angle to the central axis.

A further alternative arrangement is illustrated in figure 4b where the sheet metal strip is formed from a regular corrugated profile having a series of spaced crests 24 and troughs 25.

Turning back to the form as illustrated in figure 1, the sheet 17 is helically wound so that the pitch angle α as illustrated in figure 1, is relatively low. Further, in the illustrated form, the ribs 21 project outwardly from the tank. However it is to be appreciated that the tank may be wound so that the ribs extend inwardly. This latter option has the advantage as it provides a smoother exterior surface with the outer surface of the pans 22 forming the outer margins of the tank wall 12.

The sheet metal strip 17 is formed from a high tension or mild steel which typically incorporates a protective coating which is formed from zinc or a zinc mixture. The sheet steel may also be laminated with a protective polymer based film which provides superior chemical resistance and enhanced moisture barrier. One such polymer film is sold under the trade mark TRENCHCOAT LG which is a trade mark of the Dow Chemical Company.

Whilst not shown, the tank 10 typically also includes a lid 16 which incorporates an inlet pipe 17 to the tank 10. An outlet (also not shown) is also typically provided adjacent the base 11.

Figures 5a to 5c illustrate a connection detail of the base 11 to the peripheral wall 12. As illustrated, the lower end of the peripheral wall 12 includes an outwardly extending flange 26. Similarly the base includes a main body portion 27 and a turned lip 28. Initially, the peripheral wall 12 is located on the main body portion 27 within the turned end 28. A gasket 29 is disposed between the peripheral wall 12 and the base 11.

A lap seam is formed at the juncture between the base and the peripheral wall 12 by a roll forming operation wherein the turned end 28 is rolled back onto the

laterally extending flange 26 as best illustrated in figure 5b. This formation of the lap seam illustrated in figure 5b is effected by a roll former which proceeds around the perimeter of the water tank. However, the roll former is typically not suitable to provide an adequate seal at those regions where the rib 21 extends to the base 11. In those regions, a further crimping operation is required to form a more effective seal and this is illustrated in figure 5c.

Figure 6 illustrates the lock seam 20 which is provided in the peripheral wall and joins the longitudinal edges 18 and 19 of the metal strip. The lock seam 20 is formed by folding over lapping portions 18 and 19. A gasket 30 is disposed within the lapped portion prior to folding so that it is captured within the locked seam 20. The lock seam is designed so that outward hydrostatic pressure forces the seam into tighter engagement thereby improving the seal between the longitudinal edges 18 and 19.

As discussed in further detail below with reference to figure 14, the peripheral wall is initially formed in a circular cylinder as illustrated in figure 7. The peripheral wall is then able to be reshaped into different configurations such as the elliptical form as shown in figure 8 or the obround shown in figure 9. The advantage of this arrangement is that the tanks of different shape can all be made from a common stock. To reshape the peripheral wall 12 mandrels 50 (as illustrated in figure 7) are inserted within the peripheral wall 12 prior to connecting of the wall with the base 11. Each mandrel 50 includes mandrel parts 51 and 52 which are movable relative to each other. Each of the mandrel parts 51, 52 include an engagement surface 53 which in the illustrated form is arcuate. Through outward displacement of the mandrel parts 51 and 52 it is possible to reform the circular cylindrical wall to the elliptical shape illustrated in figure 8 or the obround shape of figure 9.

Figures 10 to 13 illustrate various reinforcing elements which can be used in conjunction with the water tank 10 so that it can be fully self supporting and able to accommodate the hydrostatic pressures induced in the tank in use. In one form illustrated in figure 10, the tank incorporates a series of metal flanges which include an inner engagement edge 32 which is designed to abut a lower margin of the peripheral wall 12. In the illustrated form, the inner edge 32 of the flanges 31 are profiled to match the profile of the tank 10. A lower edge 33 of the flanges 31 engages a support structure 34 which is connected to the base 11 or separately formed thereto.

The flanges 31 are designed to resist outward bowing of the peripheral wall and are disposed in regions where these pressures are at their highest and where the wall is at its most susceptible. In the particular arrangement where the tank is formed as an obround, the reinforcing flanges are spaced along the generally parallel surfaces 13 and 14.

Another form of reinforcing element is illustrated in figures 12 and 13 where internal ties 35 are disposed within the tank 10. The ties 35 are arranged to interconnect portions of the peripheral wall 12 so as to resist outward bowing of the peripheral wall 12 under hydrostatic pressures. In use, a plurality of the ties maybe disposed within the tank 10 between its upper and lower ends. The spacings between the ties 35 may vary along the tank and in particular, be more closely spaced towards the bottom of the tank 10 where the hydrostatic pressures are at their highest.

The tank 10 is designed so that it can be manufactured in a production line fashion. This has distinct advantages as it can substantially reduce the cost of manufacture of the tanks as compared with tanks of comparable size and performance which were hand assembled. A particular advantage of the tank design is the

manufacture of the peripheral wall 12 as formed from helically wound sheet metal strip. Incorporation of this feature enables the peripheral walls to be formed from a continuous length of metal tubing. The process of manufacture is schematically represented in figure 14.

As disclosed in figure 14, the tank 10 is manufactured in a production line fashion from flat sheet metal strip. The sheet metal strip is provided in a coil 100 and is pre-coated with the polymer film. In a first stage, the sheet is fed through a roll former 101 wherein the appropriate stiffening formations are formed in sheet to produce the profiled sheet 17. The profiled sheet is then helically wound to form a continuous cylinder 103 at step 102. The cylinder wall 103 is continuous with the lock seam 20 interconnecting the longitudinal edges 18 and 19 of the sheet 17. The cylinder 102 then progresses to a shearing station 104 which cuts the cylinder into discrete lengths to thereby form the individual wall sections 12 of the tank.

At stage 105, one or more mandrels 50 is inserted into the peripheral wall 12 so as to reshape it into its desired configuration. The reshaped peripheral wall 12 is then passed to a subsequent station 106 wherein the base is located over one end of the peripheral wall 12. The base is supplied from a store 107. The flange 26 is formed at the outer edge of the peripheral wall 12 and thereafter, a roll former 108 folds over the turned end 28 of the base to form the lap seam. A crimping apparatus 109 then traverses around the base to seal the base to the peripheral wall 12 in those regions where required, particularly where a rib 21 extends into the bottom lap seam.

In accordance with the present invention, an improved water tank is provided which can be produced in a production line fashion thereby significantly reducing the costs of manufacture over prior art water tanks that are hand assembled. The water tank may be formed in various

cross sectional profiles and include different strengthening rib configurations as required.

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprising" is used in an inclusive sense, i.e. the features specified may be associated with further features in various embodiments of the invention.

Variations and or modifications may be made to the parts previously described without departing from the spirit or ambient of the present invention.

CLAIMS

1. A water storage tank having a base, and a peripheral wall upstanding from the base and extending about a central axis of the tank, the peripheral wall being formed from one or more lengths of sheet material, each sheet being helically wound about the tank axis, at least one of the sheets being formed of metal strip having at least one stiffening formation disposed between opposite longitudinal edges of the sheet, the wall further comprising at least one seam extending helically about the tank axis and forming a join at the longitudinal edges of the or each sheet so that the peripheral wall is continuous.

2. A water storage tank according to claim 1, wherein each stiffening formation includes at least one rib that extends helically about the tank axis.

3. A water storage tank according to claim 2, comprising a plurality of ribs that extend helically about the tank axis.

4. A water storage tank according to claim 2 or 3, wherein the pitch angle of the or each rib is low.

5. A water storage tank according to any preceding claim, wherein each stiffening formation includes a plurality of ribs that extend generally in the direction of the tank axis.

6. A water storage tank according to any preceding claim, wherein the peripheral wall is formed from a single length of sheet metal strip.

7. A water storage tank according to any one of claims 1 to 5, wherein the peripheral wall is formed from a plurality of lengths of sheet metal strip.

8. A water storage tank according to any preceding claim, wherein the peripheral wall is generally circular in cross-section perpendicular to the tank axis.

9. A water storage tank according to any one of claims 1

to 7, wherein the peripheral wall is non-circular in cross-section perpendicular to the tank axis.

10. A water storage tank according to claim 9, wherein the peripheral wall is generally elliptical or obround in cross-section.

11. A water storage tank according to any preceding claim, wherein the at least one seam is a lock seam.

12. A water storage tank according to any preceding claim, wherein a lower edge of the peripheral wall is generally planar and disposed perpendicular to the tank axis.

13. A water storage tank according to claim 12, wherein the base is formed from sheet material and is interconnected to the lower edge of the peripheral wall by a seam.

14. A water storage tank according to claim 13, wherein the seam joining the base with the peripheral wall comprises a roll formed lock seam.

15. A water storage tank according to any preceding claim, further comprising spacer means disposed within the peripheral wall, the space means interconnecting portions of the peripheral wall and being operative to resist outward bowing of the peripheral wall.

16. A water storage tank according to claim 15, wherein the spacer means is in the form of a plurality of metal ties.

17. A water storage tank according to any preceding claim, further comprising stiffening elements engaging an outer surface of the peripheral wall adjacent the base.

18. A water storage tank according to claim 17, wherein the stiffening elements are in the form of a plurality of metal flanges.

19. A method of manufacturing a water storage tank having a base and a tank wall upstanding from the base, the method comprising the steps of:

- helically winding at least one length of sheet material about a central axis to form a cylinder;

- forming a join at the longitudinal edges of the or each sheet so that the wall of the cylinder is continuous;
- cutting the cylinder transverse to the central axis to separate the tank wall from the cylinder;
- locating a base at one end of the tank wall; and
- joining the base to the tank wall.

20. A method according to claim 19, wherein one of the lengths of sheet material is sheet metal and the method further comprises the step of roll forming the sheet metal strip to incorporate stiffening formations in the sheet, and using the roll formed sheet in forming the cylinder.

21. A method according to either claim 19 or 20, further comprising the step of reshaping the tank wall to change the shape of the wall in cross section perpendicular to the cylinder axis; and joining the base to the reshaped tank wall.

22. A method according to claim 21, wherein the step of reshaping the tank wall occurs after the step of cutting the cylinder.

23. A method according to claim 21, wherein the step of reshaping the tank wall occurs before the cylinder is cut.

24. A method according to any one of claims 19 to 23, wherein the base is joined to the tank wall by a lock seam and wherein the lock seam is formed at least in part by a roll forming operation.

25. A method according to claim 24, wherein the lock seam is formed in at least in part by a crimping operation.

26. A method according to any one of claims 19 to 25, wherein the join at the longitudinal edges of the or each sheet is a lock seam formed by a roll forming operation.

27. A method according to any one of claims 19 to 26, wherein the cylinder is formed from a single length of sheet material.

28. A method according to any one of claims 19 to 27, wherein the tank is manufactured in a production line facility wherein the methods steps are repeated to produce a plurality of water tanks and wherein the cylinder is

formed by a continuous process from at least one coil of sheet material.

29. A method of manufacturing water storage tanks having a base and a peripheral wall upstanding from the base, wherein the peripheral wall of a plurality of tanks is formed in continuous process by helically winding at least one length of sheet material about a central axis to form a cylinder, forming a join at the longitudinal edges of the or each sheet strip so that the wall of the cylinder is continuous, and cutting the cylinder at discrete intervals to form the individual peripheral walls.

30. A production line facility to manufacture water storage tanks, the production line facility being operative to carry out the method of any one of claims 19 to 28.

31. A water storage tank substantially as herein described with reference to the accompanying drawings.

32. A method of manufacturing of a water storage tank substantially as herein described with reference to the accompanying drawings.

33. A production line facility to manufacture water storage tanks substantially as herein described with reference to the accompanying drawings.

Dated this 11th day of July 2003
BHP STEEL LIMITED
By their Patent Attorneys
GRIFFITH HACK

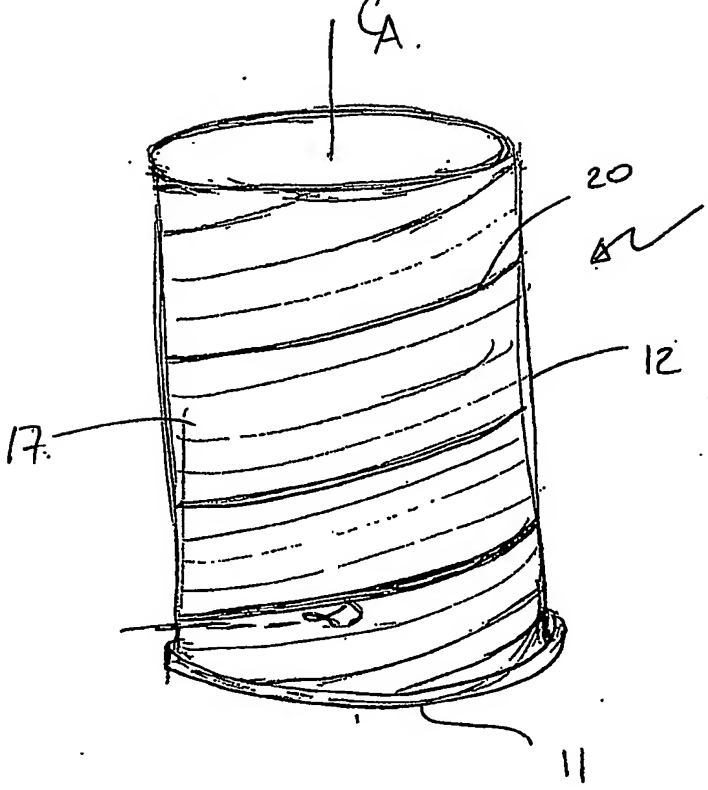

FIG 1

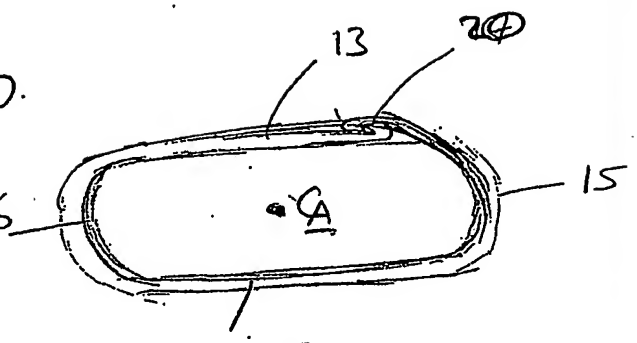

FIG 2

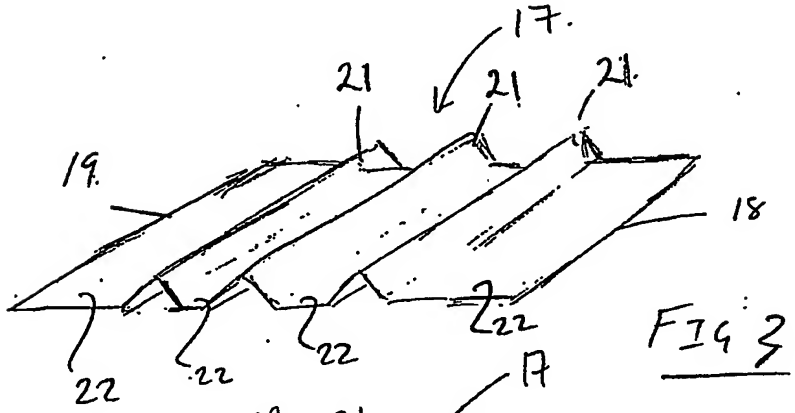

FIG 3.

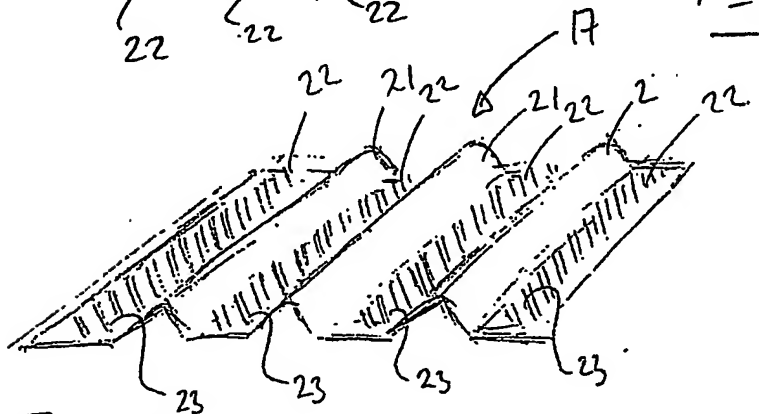

FIG 4a

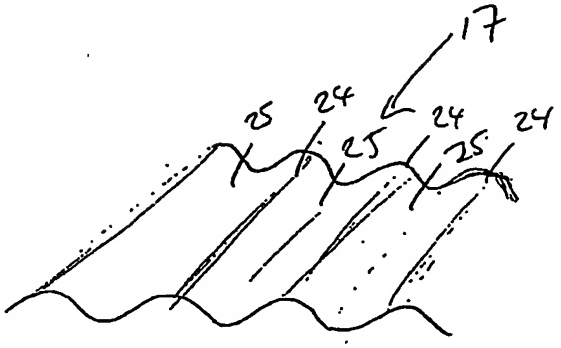

FIG. 4b

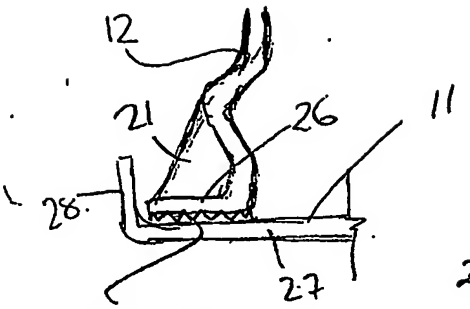

FIG 5A.

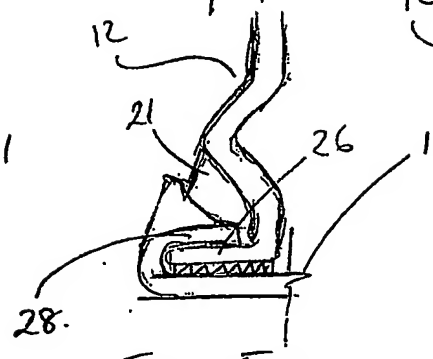

FIG 5B.

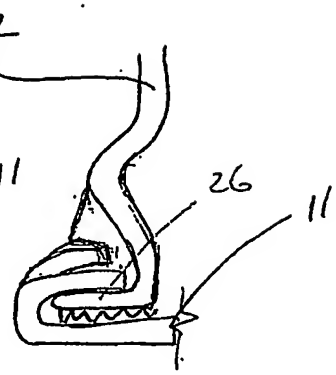

FIG 5C

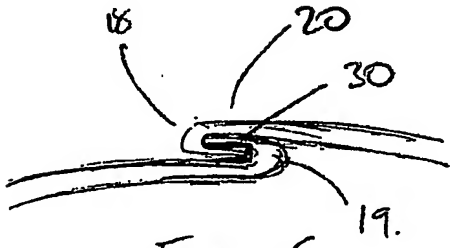

FIG 6.

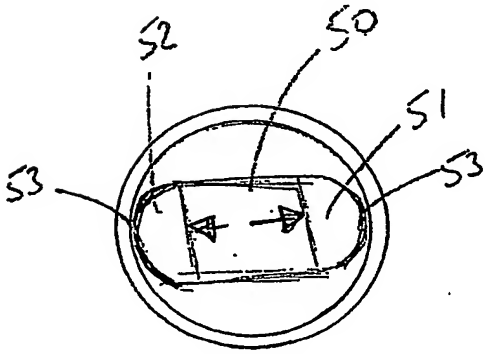

FIG 7

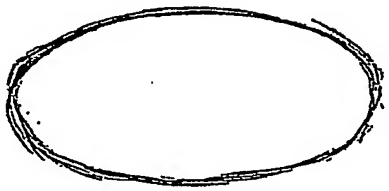

FIG 8.

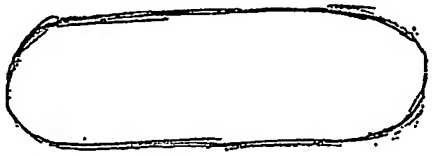

FIG 9.

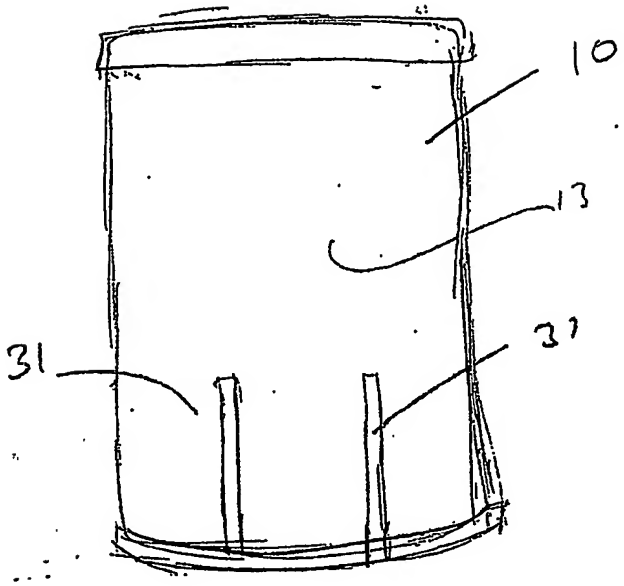

FIG 10

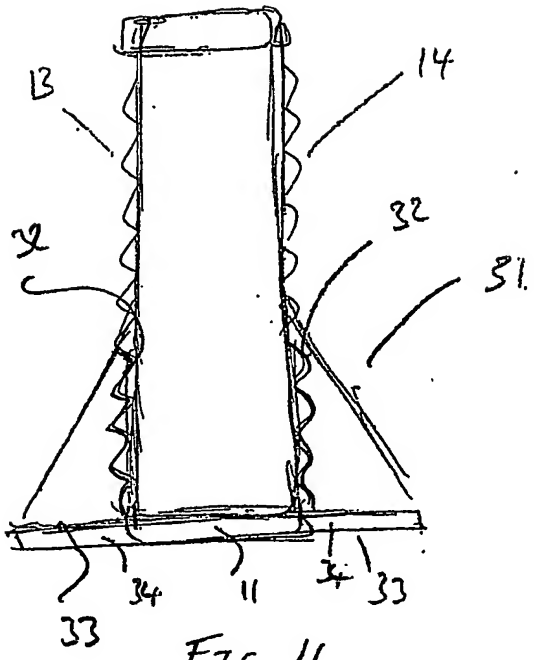

FIG 11

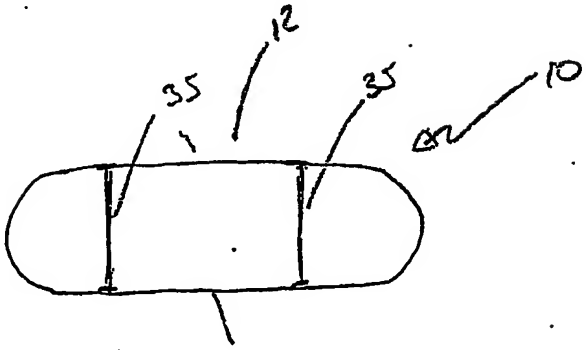

FIG 12

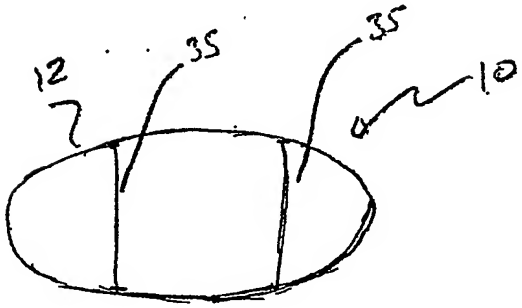

FIG 13

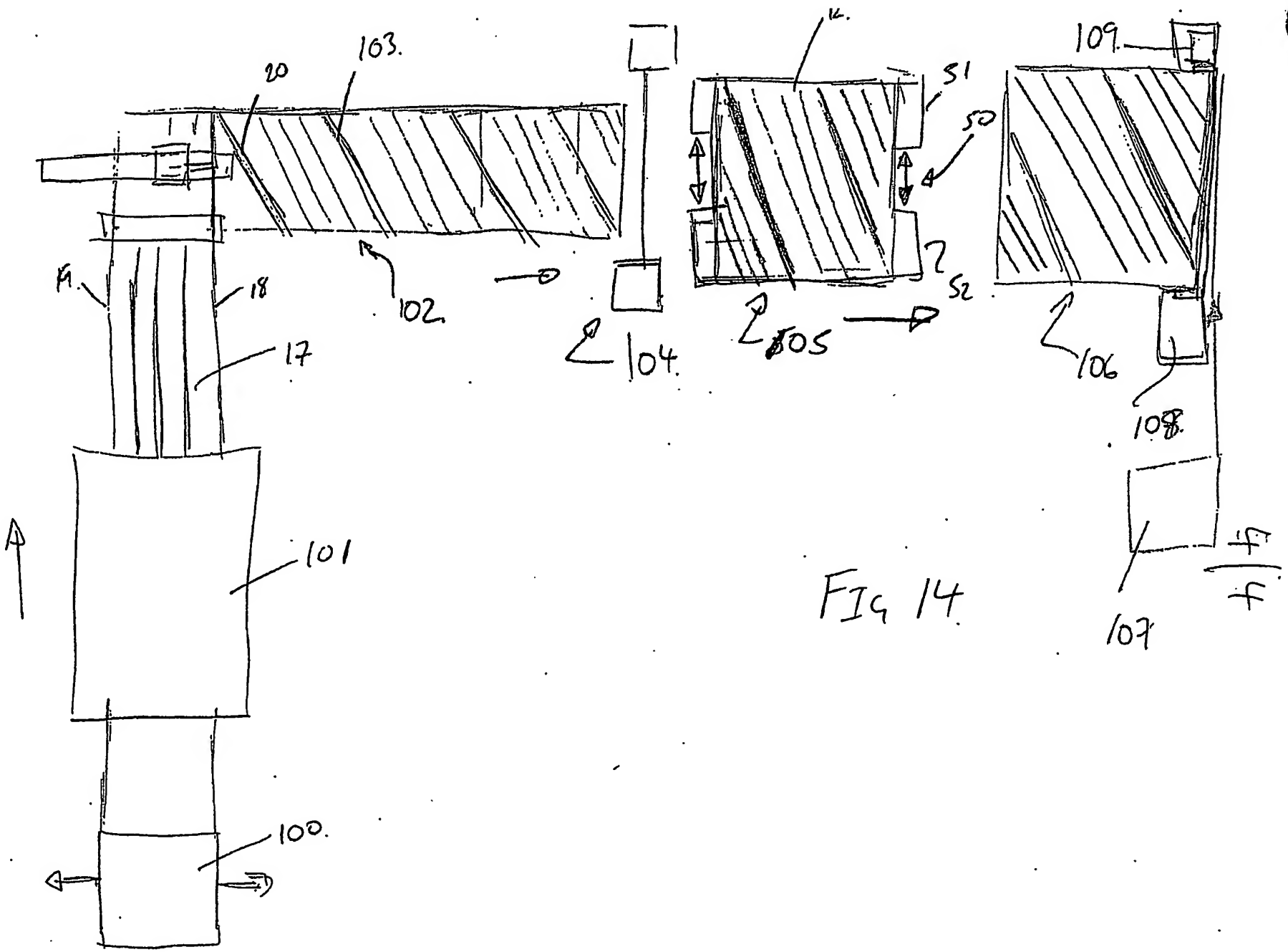

FIG 14.